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THE CEREAL CYST NEMATODE, *HETERODERA AVENAE*

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The cereal cyst nematode, ***Heterodera avenae*** Wollenweber 1924, is one of the most important plant parasitic nematodes of cereals (barley, oats, rye, wheat). It is cosmopolitan in distribution and has been found in 31 countries where cereals are cultivated. ***Heterodera avenae*** has been reported from Idaho, Michigan, Oregon, and Washington in the United States. The cyst stage is able to withstand harsh environmental conditions and is spread through the movement of soil with machinery, animals, water, dust storms, and any means by which soil is disseminated.

Disease Cycle

The time of root penetration and nematode development is dependent on edaphic and agronomic factors for a given geographical area and plant cultivar. In Europe and Canada, autumn-sown (October-November) cereals are penetrated by second-stage juveniles soon after seed germination, but nematode development is suspended during the winter and is completed in the spring. Females can be found on plant roots as early as April. In spring-sown (March-April) fields, however, the nematode overwinters in the egg stage and invades newly planted spring grain at temperatures as low as 4 C in mid-March. The juvenile soil population usually peaks in April or May and declines sharply in June. Females can be found on plant roots within 90 days after penetration under optimum developmental temperatures. Similar biological responses probably occur in the United States. There is only one nematode generation per year, and the life cycle requires between three and four months under optimum environmental conditions.

Heterodera avenae is found in all soil types, but prefers light soils with good physical structure, and not heavy, poorly structured soils. Low soil temperatures (5-15 C) and high soil moisture stimulate hatching, and it has been shown that a minimum dormancy period of eight weeks at low soil temperatures are required to obtain substantial hatching.

Symptoms

Females are initially white in appearance (Fig. 1) and turn from cream colored to brown and almost black when they die and become cysts. Nematode symptoms can be readily detected on infected plants by the matted root appearance and secondary root proliferation (Fig. 2). Heavily infected plants show a general overall stunted appearance, a reduction in tillering, and cereal heads are usually small and poorly filled. There may be a burning of the leaves, similar to that caused by a drought condition. This is due to the nematode interfering with the metabolic balance of the plant and inhibiting hydrostatic water pressure that results in wilting. Cereal heads of parasitized plants may remain upright and contain small or aborted seeds, while heads of nonparasitized plants droop because they are full of ripened and well developed seeds. Yield

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losses to *H. avenae* have been reported as high as 73-89% in Australia.

Damage Threshold

The damage threshold level of *H. avenae* differs not only between plant cultivars but also between geographical areas. The damage threshold level is lower for Australia than for Europe, due to environmental and climatic conditions during the growing season; nematode soil populations of 2 eggs/g soil can suppress grain yields of susceptible wheat cultivars by 25%. Soil populations of 3-5 eggs/g of soil are common while 10 eggs/g soil are not uncommon. Threshold levels are also affected by the association of *H. avenae* with other plant pathogens. A combination of *H. avenae* and *Rhizoctonia solani* Kuhn reduces yields below that of single inoculations of either pathogen. Although *H. avenae* is economically important on cereals, it has also been found on fescue, ryegrass, brome, and Kentucky bluegrass.

Management Considerations

Resistance is the major source of nematode control, and excellent plant growth has been obtained with susceptible cultivars used in rotation with resistant cultivars of non host plants (Fig. 3). Although *H. avenae* pathotypes have been found, cereal breeders have been successful in incorporating resistance, which appears to be due to a single dominant gene, into important cereal varieties.

Chemicals are usually not considered in a nematode control program on cereals because of economic considerations. However, significant increases in grain yields, have been obtained in Australia with several nematicides, including a methyl bromide-chloropicrin mixture, DBCP, EDB, and several nonfumigant nematicides. In Australia, EDB at a rate of 3.7 l/ha was the first nematicide used commercially to control *H. avenae*, and in-row treatments of 0.3 kg/ha of methomyl or aldicarb have given excellent control (Fig. 4).

Proper cultural practices can result in effective nematode control. A crop rotation of fallow-wheat-legume has been shown to be an effective rotational control practice.

Fungal parasites can play an important role in *H. avenae* control. Nematodes parasitized by *Verticillium chlamydosporium* and *Nematophora gynophila* fail to increase their densities on host plants. Females may mature and reproduce on plant roots, but their fecundity is reduced.

Detection

The cereal cyst nematode is not presently known to occur in cereal crops grown in Florida. While this parasite is considered primarily a problem in more temperate climates, there are physiological races of this nematode which have adapted to warmer areas. Specialists should be aware of potential problems that may occur with this pest, and if any unusual symptoms as described are observed, samples should be submitted to the D.P.I. nematology laboratory for examination, to adopt proper regulatory actions.

REFERENCES

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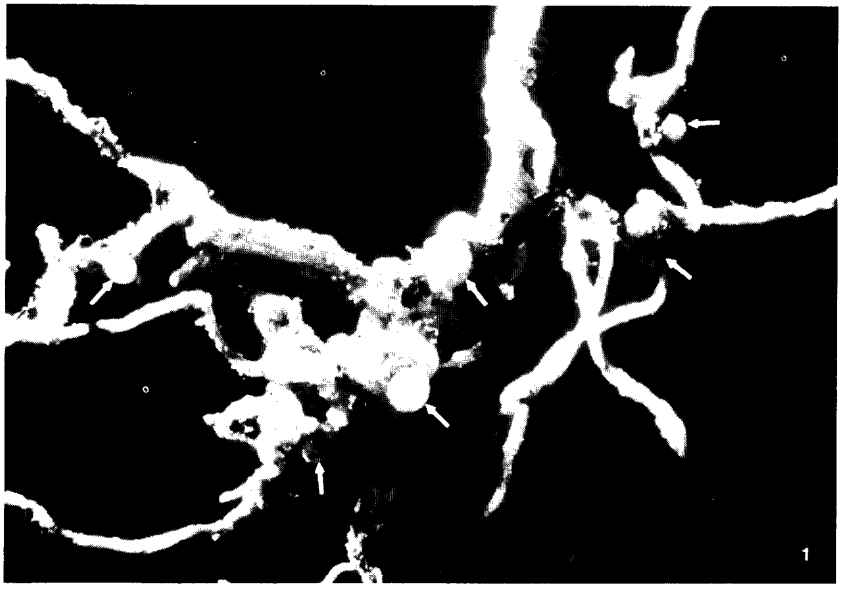

Fig. 1. ***Heterodera avenae*** white females (arrow) and cysts on cereal roots. (Courtesy of R. H. Brown).

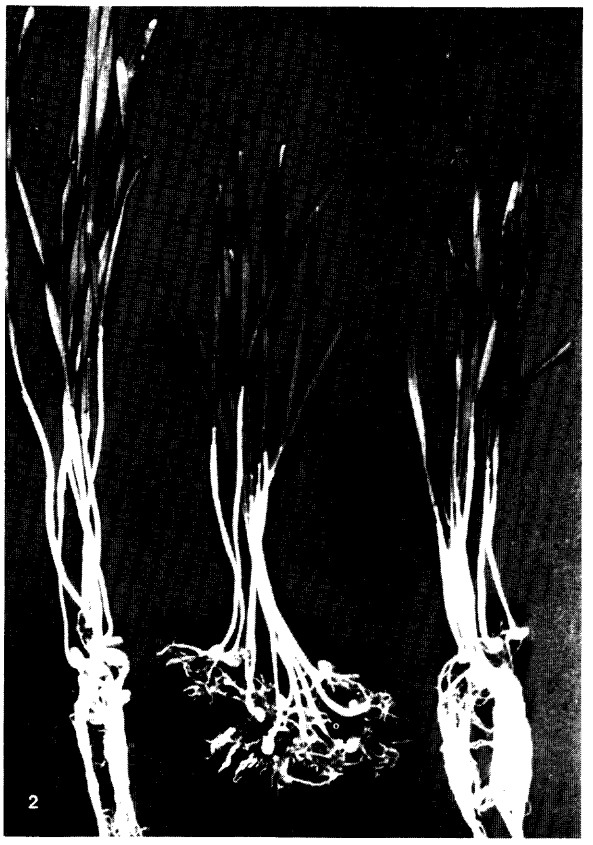

Fig. 2. Effect of ***Heterodera avenae*** on growth of wheat. Left and right, nematode free plants; center, nematode parasitized plant. (After Rovira, 1982).

Fig. 3. Importance of resistance on the growth of grain in *Heterodera avenae* infested soil. Left, susceptible wheat. Right, resistant rye. (Courtesy of R. H. Brown).

Fig. 4. Control of *Heterodera avenae* on wheat. Left and right, nematicidal treatments; center, untreated plot. (Courtesy of R. H. Brown).

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